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Tensile Failure Analysis and Residual Strength Prediction of CFRP Laminates with open hole

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Abstract

Failure patterns and damage mechanism of CCF300/QY8911 and T300/QY8911 composite laminates with open hole had been investigated experimentally and numerically. CCF300/QY8911 composite laminates with a weak interfacial strength produced massive delaminations and splitting bonds which relieved the stress concentration, thus having a higher strength. T300/QY8911 composite laminates with a higher interfacial strength presented to be brittle fracture with much less delaminations. The failure process, delamination propagation and residual strengths had been simulated and predicted by 2D and 3D Finite element (FE) modeling techniques. The delamination that allowed damage to join up and propagate through the thickness of the laminate had been identified as the critical character for residual strength prediction, which was compared in the simulation detailed. In the 2D modeling it made a good strength prediction for T300/QY8911 composite, but not for CCF300/QY8911 composite which contained massive delaminations and not been considered in this model. However, the 3D model proposed by our study could well simulate the delamination progressive propagation process, and predict the residual strength accurately. Furthermore, the effect of delamination defect around the hole that was unavoidable during hole drilling process was also investigated by the 3D modeling.

Key words

Fiber reinforced composites; Failure mechanism analysis; Delamination propagation; Strength Prediction; Finite element model; Microscope Photograph

1. Introduction

As one of the most important structural materials for their less density, excellent stiffness and high intensity, Carbon fiber reinforced polymer (CFRP) laminates ~~were which~~ have been increasingly used in aircraft, automotive and marine structures [1-6]. As many composite structures, such as aircraft frames, contain thousands of holes for joining purposes, a better understanding of failure mechanism are required in the presence of open hole[7-10]. However, due to anisotropy, brittleness, heterogeneity and that interlamination property far below in-plate property, their failure patterns and damage mechanism were complex, especially during the loading stage in a composite laminate are increased due to the presence of a stress concentration,

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